Decision Support System for Selecting the Best Firefighters Using the Weighted Sum Model (WSM) Method

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Abstract

Fire is a threat to human safety, property and the environment. The population is getting denser, the construction of office buildings, residential areas, and industry are growing, creating a vulnerability in the event of a fire, which requires special handling. This research uses the Weighted Sum Model (WSM) method. The WSM method is a method for solving a complex, unstructured situation into several components in a hierarchical order, by giving a subjective value regarding the relative importance of each variable, and determining which variable has the highest priority in order to influence the outcome of the situation. The decision making process is basically choosing the best alternative. Such as structuring problems, determining alternatives, determining possible values for aleatory variables, determining values, time preference requirements, and risk specifications. The results of the research show that the use of WSM as a decision support system model for selecting the Best Firefighters for the Lubuk Basung Damkar Dam can help the admin in determining the Best Members with a multi-criteria weighting and selection process that is faster, more accurate and more effective, based on calculations to find out who is the best member of Alternative 3 with the name Yurnaldi, S.Pd with a score of 80.

Keywords: Decision Support System, Weighted Sum Model Method, Fire Fighting, Alternatives, Specifications.

1. Introduction

The development of communication and information technology has now reached the level of vital human needs. Not only in its use as a channel for communicating information between individuals in social interactions, but also in a wider scope between institutions and institutions, between regions and regions and between countries and continents [1]

The presence of computers has brought changes in human work patterns. Computers as sophisticated tools can be programmed to process data quickly, accurately and in large volumes. Various complex human jobs, which would take a long time if done manually, have been taken over by computers. Computers have touched almost all aspects of human life [2]

The Lubuk Basung Fire Department is a fire department office that wants to select the best members for their performance on duty. In carrying out its activities, the Lubuk Basung Fire Department together selects the best members who will later be given awards as a result of the members' hard work. This selection process often experiences several problems, such as calculating member criteria values which are often similar to one another. The process of selecting the best members involves all firefighting members who work at the Lubuk Basung Fire Department Office. This process has several assessment stages which can take a long time to calculate the value of each member. In this process, it

is not uncommon for several errors to occur both in imputing member scores and in the process of calculating these scores. Decision Support Systems are an alternative solution to this problem.

Decision Support System (DSS) is a computer-based system designed to assist decision makers in utilizing certain data and models to overcome various semi-structured and unstructured problems [3]

One method that can be used in decision support systems is the weighted sum model (WSM). Weight Sum Model (WSM) is the best known and simple multi-criteria decision making method for evaluating a number of alternatives in terms of a number of decision criteria [4]

A system is a combination of elements or components that are connected to each other with the aim of facilitating the flow of information, material or energy to achieve a goal. In this context, the definition of a system refers to a group of elements or elements that are interconnected and influence each other in a joint effort to achieve a target or goal [5]

A collection of activities that involve extracting, processing, storing, processing, monitoring and reporting data with the aim of producing information that supports the decision-making process in an organization to achieve predetermined goals and objectives [6]. An information system is a system within an organization that integrates the needs for processing daily transactions, supports managerial and

strategic activities of the organization, and provides reports required by external parties [7]

Decision Support Systems (DSS) are computer-based systems that assist managers in solving semi-structured problems. It is an interactive information system that provides information, modeling and data manipulation to support the decision-making process in semi-structured to unstructured situations, where decisions often lack definite guidance [8]

The WSM method is used to determine the potential value of an alternative by considering certain criteria. To solve the MCDM problem, one can use the WSM method. The relative weights of the criteria and alternative performance values are required in the calculations [9] The WSM method is one of the simplest methods and is easy to understand in its application because in the concept of this method it only multiplies the Criteria Weight (Wj) and the Alternative value (Wij) [10].

Previous research using the WSM method for determining public health insurance participants found that the WSM method is one of the MCDM methods that is very simple to implement and can help decision makers produce the best decision from several alternatives. The application of WSM does not differentiate between benefit or cost criteria, so the weight range greatly influences the calculation of the best results [11]. Furthermore, the research determined the best hospital referral for BPJS patients using the WSM method, obtaining the highest score of 77.5 , namely at RS3. Therefore, this hospital is the leading hospital as a reference for BPJS patients. It is hoped that this research can help the Puskesmas or Level I Health Facilities in the city of Medan in providing hospital referrals for BPJS patients [12].

In general, a database is an arrangement or collection of data records stored on a computer. The connection between elements in the database can be used as a source of information for users. Until now, there are still many database records that are still displayed in text form as information for users. [10]

MySQL is a database that contains one or a number of tables. Tables consist of a number of rows and each row contains one or a number of tables. Tables consist of a number of rows and each row contains one or a number of tables. MySQL is an open source database server that is quite popular. With its various advantages, this database software is widely used by practitioners to build projects. The existence of the API (Application Programming Interface) facility owned by MySQL, allows various computer applications written in various programming languages to access the MySQL database [11].

2. Research methodology

A research framework is a form of framework that can be used as an approach to solving problems. The framework that the author uses can be seen in Figure 1 below:
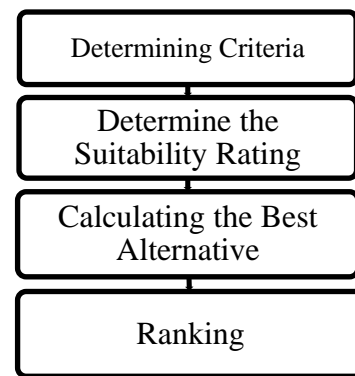

Figure 1. Research Framework

Research stages are a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows:

2.1 Determining Preference Criteria and Weights
The first step in the Weight Sum Model (WSM) method is to identify the relevant criteria that will be used to evaluate the alternatives or options in a decision. Identification of these criteria involves a deep understanding of the problem or situation to be resolved through decision making, as well as selecting the most relevant and important criteria in that context. Next , give weight to each criterion to indicate the level of importance of the criterion in decision making. This weighting makes it possible to give appropriate priority to each criterion, which will influence the calculation of the final score for each alternative in the decision making process. These criteria must cover all aspects that are relevant and can influence the decision to be taken, so that an accurate representation of the decision can be achieved

2.2 Determine the Suitability Rating of each Alternative
The second step in the Weight Sum Model (WSM) method is to determine the suitability rating for each alternative being evaluated. Give a value or score to each alternative related to each criterion identified in the first step. This rating reflects the extent to which each alternative meets or matches predetermined criteria. Ratings can be done in various ways , depending on the type of data used. For example, if the data is numerical, then assessment can be done by assigning values based on predetermined criteria. If the data is qualitative, then assessment can be done by providing a qualitative rating or label.

2.3 Calculating the Best Alternative
Calculate the best alternative based on the assessment results and the weight of the criteria that have been determined. In this calculation, for each alternative, multiply the suitability rating for each criterion by the

previously determined criteria weight. Then, the results of this multiplication are added up for each alternative. The final result of this calculation will provide a final score for each alternative. The alternative with the highest final score is considered the best alternative or optimal choice in decision making. Thus, this step is the stage of determining the most suitable alternative based on the criteria and weights that have been previously determined. This calculation uses the following formula:

$$Ai \ WSM - Score = \sum w \ n \ j = i \ j \ xij$$

Where :

n = .number of criteria
wj = weight of each criterion
xij = matrix value x

2.4 Ranking

Ranking in the Weight Sum Model (WSM) method is the final stage of the decision making process, where the alternatives being evaluated are ranked based on the final score that has been calculated. The alternative with the highest final score will receive the top ranking, while those with a lower score will be given a lower ranking in order of their scores.

3. Results and Discussion

3.1 Calculation of the Weighted Sum Model Method

In the Weighted Sum Model method, it is necessary to determine criteria that serve as guidelines for selecting the best fire brigade members. Determine the criteria and the weights for each predetermined criterion. The following are the criteria and weights in selecting the best fire brigade members which can be seen from Table 1 below:

1. Determining Preference Criteria and Weights
The criteria that will be used in the research can be seen in Table 1 below:

Table 1 Table of Criteria and Weights

No	Criteria	Code	Preference Weights
1	Behavior	C1	0.2
2	Ability	C2	0.2
3	Discipline	C3	0.3
4	Education	C4	0.1
5	Work Experience	C5	0.2

The table above can help determine how each criterion will influence the evaluation and ranking of alternatives in the decision making process. The preference weight given to each criterion reflects the priorities and preferences of the decision maker regarding the aspects that must be considered in

selecting the optimal alternative. Next, a value conversion table will be displayed for each criterion.

Table 2 Conversion of Behavioral Criteria Values

No	Behavioral Values	Score
1	Very good	100
2	Pretty good	75
3	Not good	50
4	Not good	25

Table 3 Conversion of Criteria Values Ability

No	Ability Value	Score
1	Very good	100
2	Pretty good	75
3	Not good	50
4	Not good	25

Table 4 Conversion of Discipline Criteria Values

No	Discipline Values	Score
1	Very Disciplined	100
2	Just be disciplined	75
3	Lack of Discipline	50
4	Undisciplined	25

Table 5 Conversion of Educational Criteria Values

No	The Value of Education	Score
1	S1	100
2	D3	75
3	high school	50
4	junior high school	25

T able 6 Conversion of Work Experience Criteria Values

No	Work Experience Value	Score
1	Very experienced	100
2	Experienced enough	75
3	Inexperienced	50
4	Inexperienced	25

The value conversion table for each criterion is a very important tool in the multi-criteria decision making process. This table is used to change or convert criteria assessment values from various scales or units into a uniform or standard scale. In other words, this conversion table helps ensure that assessments of different criteria can be compared and used in the process of ranking alternatives objectively.

2. Determine the Suitability Rating of each Alternative

Determine the suitability rating for each alternative for each criterion described in Table 7 as follows:

Table 7 Suitability Rating for Each Alternative

No	Alternative	C1	C2	C3	C4	C5
1	A001	100	75	75	100	50
2	A002	50	75	50	100	75
3	A003	50	75	100	100	75
4	A004	75	50	25	75	25
5	A005	75	100	50	50	100
6	A006	50	50	25	50	100
7	A007	75	50	100	50	50

Table 7 above is the basis for calculating the final score for each alternative in the multi-criteria decision making method. By using this table, you can analyze the extent to which each alternative meets each criterion, which will then be used in the alternative ranking process to determine the optimal choice according to the criteria and preference weights that have been previously determined.

3. Calculating the Best Alternative

$$Ai\ WSM - Score = \sum w\ n\ j = i\ j\ xij$$

Calculations are carried out to find the best alternative.

Alternative 1
$A1 = (100x0.2) + (75x0.2) + (75x0.3)$
$\qquad\qquad + (100x0.1) + (50x0.2)$
$= 20 + 15 + 22.5 + 10 + 10 = 77.5$

Alternative 2
$A2 = (50x0.2) + (75x0.2) + (50x0.3) + (100x0.1)$
$\qquad\qquad + (75x0.2)$
$= 10 + 15 + 15 + 10 + 15 = 65$

Alternative 3
$A3 = (50x0.2) + (75x0.2) + (100x0.3)$
$\qquad\qquad + (100x0.1) + (75x0.2)$
$= 10 + 15 + 30 + 10 + 15 = 80$

Alternative 4
$A4 = (75x0.2) + (50x0.2) + (25x0.3) + (75x0.1)$
$\qquad\qquad + (25x0.2)$
$15 + 10 + 7.5 + 7.5 + 5 = 45$

Alternative 5
$A5 = (75x0.2) + (100x0.2) + (50x0.3) + (50x0.1)$
$\qquad\qquad + (100x0.2)$
$15 + 20 + 15 + 5 + 20 = 75$

Alternative 6
$A6 = (50x0.2) + (50x0.2) + (25x0.3) + (50x0.1)$
$\qquad\qquad + (100x0.2)$
$10 + 10 + 7.5 + 5 + 20 = 52.5$

Alternative 7
$A7 = (75x0.2) + (50x0.2) + (100x0.3) + (50x0.1)$
$\qquad\qquad + (50x0.2)$
$15 + 10 + 30 + 5 + 10 = 70$

After the calculations have been carried out, they are described in Table 8 below:

Table 8 Calculation Data

No	Alternative name	Alternative Code	AI value
1	Chandra, S	A001	77.5
2	Rince, SH	A002	65
3	Yurnaldi, S.Pd	A003	80
4	Anton Asmara. Amd	A004	45
5	Darman	A005	75
6	Ramli	A006	52.5
7	Mawardi	A007	70

4. Ranking

After the calculations have been carried out, the ranking will continue, which can be seen in Table 9 below:

Table 9 Ranking Data

| No	Alternative name	Alternative Code	AI value
1	Yurnaldi, S.Pd	A003	80
2	Chandra, S	A001	77.5
3	Darman	A005	75
4	Mawardi	A007	70
5	Rince, SH	A002	65
6	Ramli	A006	52.5
7	Anton Asmara. Amd	A004	45

In the table above it can be seen that the one with the highest score is Alternative 3 with the name Yurnaldi, S.Pd with a score of 80.

3.2 System Testing
After processing the data manually using the *WSM method* , it is necessary to test the data by building an application using the *WSM method* using the PHP programming language and MySQL database.

1. Login Page

Page login only can used by admin, with the use of being able to manage data in the system, such as saving, changing, deleting and printing data, can be seen in Figure 2 below:
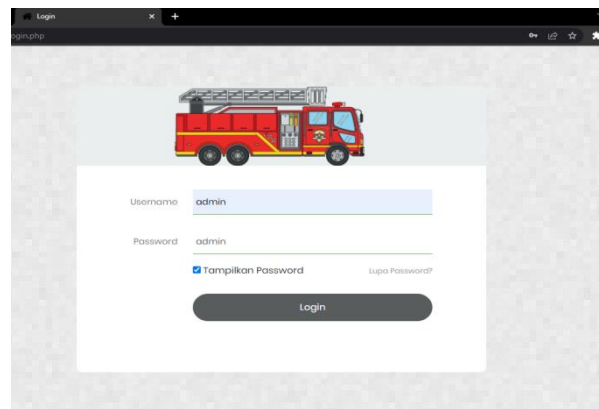
Picture 2 Pages Login

2. Criteria and Weight Data Page

weights page is useful for admins to manage existing criteria and weights, which can be seen in Figure 3 below:

Picture 3 Pages of Criteria and Weight Data

3. Calculation Value Process data page

Page Calculation Value Process data is a form for viewing the calculation process, which can be seen in Figure 4 below:

Picture 4 Pages of Calculation Process Data

4. Ranking Data Results Page

Page Ranking Data Results containing information Ranking data from highest to lowest can be seen in Figure 5 below:

Picture 5 Pages of Ranking Data Results

4. Conclusion

Based on research, this decision selection system has been designed to help the Fire Department in selecting the best members using the weighted sum model method. The weighted sum model method applied in determining the selection of the best members is considered to have helped the Fire Department in determining their choice. By using the weighted sum model in the decision support system for determining the selection of Fire Department members, it can provide optimal recommendation results

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